

## Review Article

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# An Overview of the Various Uses of *Ephedra distachya* L. from the Past to the Present

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**Abstract**

**Background:** Nowadays, many people believe in traditional medicines and use them for different diseases. Knowledge of medicinal plants and traditional medicine has been practiced for centuries through trial and error, and many important treatments for the disease have been passed down from one generation to the next. Ephedra is a valuable plant and has been used to treat diseases since ancient times. Accordingly, this study aims to comprehensively introduce *Ephedra distachya* L. in traditional medicine.

**Methods:** In this review study, databases such as Google Scholar, SID, Scopus, and books on medicinal plants in Persian and English languages were searched to collect data. The keywords included “ephedra”, “traditional medicine”, “goat’s beard”, and “medicinal plants”.

**Results:** Many resources highlighted the importance of using ephedra due to its useful properties. Experimental studies in traditional medicine show the effect of this plant in the prevention of diseases, such as asthma and bronchitis.

**Conclusion:** Considering the beneficial effects of ephedra and scientific evidence about its effects, further studies are needed to better understand the use of this plant in traditional medicine.

**Keywords:** Ephedra, Traditional medicine, Medicinal plants, Hoom, Ephedrine

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**Introduction**

Iran has a long history of using traditional medicine and medicinal plants in the treatment of diseases. The richness of Iranian plant flora and the high knowledge of Iranians in the use of medicinal plants, the existence of reputable scientific centers and authoritative scientific sources such as Ibn Sina’s *Law* book, caused to pay attention to this science (1). The ephedra plant, scientifically named *Ephedra distachya* L., belongs to the Ephedraceae family and is the intermediate point between intruders and invertebrates. The Ephedraceae family has a genus called Ephedra and more than 50 species. So far, 11 species of this genus have been identified in Iran (2). The different genera of this plant are found in the form of shrubs and sometimes ascending, which are known by different names, including in Karaj (Ormak), in West Azerbaijan province (Qatreh Ghorurokhi), in Mianeh (Padarkh), in Kavir (Anarak), and in Chehel Cheshmeh and other parts of Fars province (Ali Junak); it has also been identified as goat’s beard in some books. In one of the documents, “Hoom” mentions the name of the sacred plant of Zoroastrians for this plant. Research has shown that ephedrine and the salt in the plant have medicinal properties. Today, the active ingredients of stems, leaves, and roots are traditionally used to treat asthma, bronchitis, and nasal congestion. In

addition to traditional applications, the plant is now used in the production of dietary supplements to lose weight and strengthen muscles in athletes (3). The geographical distribution of this species is in Iran, Turkey, Europe, the Caucasus, Central Asia, Siberia, and Russia.

Ephedra is one of the most important and ancient of medicinal plants that has not been studied in a comprehensive review yet. Accordingly, the present study aimed to comprehensively review this plant.

**Historical background of *Ephedra distachya* L. (Hoom)**

*Ephedra distachya* L. has been well-known to Iranians since 2,800 years ago, and Zoroastrian Moghan used it in special ceremonies. In Iran, “Hoom” or “Hoomeh” was a well-known name for *Ephedra distachya* L. Hoom is a plant with a history of several thousand years. The ancients struck the stems of the Hoom in the mortar, took it, and drank it as a pure beverage or with milk and other additives. This practice gradually took on a religious form, and later, even without a Hoom, it was used to beat the mortar, and to invite people to the prayer ceremony. In China, the plant was used medicinally in the 2800s BC. The Chinese have been brewing this plant for a long time. Ma Huanggn (meaning yellow hemp) is made from decoction and Ma Huang is made from stems and twigs and is used to treat

colds, asthma, high fever, bronchitis, arthritis, low blood pressure, and hives. On the other hand, Ma Huang, which is obtained from the decoction of roots and rhizomes, has a more limited use and is useful in treating excessive night sweats. Western medicine became interested in the plant in 1923 after observing the effects of ephedrine alkaloids. Ephedrine compounds were developed in 1927 and have since been widely used to treat severe colds and allergies (4).

### Plant Names

Scientific name: *Ephedra distachya* L. (Figure 1); English name: Sea grape, Sand cherry; French name: Ephe`dra, Raisin de mer; Italian name: Uva di mortra; Arabic name: Alad; and Persian name: Goat's beard, Armak, Hoom (5).



Figure 1. *Ephedra Distachya* L.

### Botanical Specifications

It is a perennial plant with a height of 0.30 to about 1 m and has a greenish-gray (dusty) stem. The plant has non-grooved stems, the male flowers are clustered, and the female flowers are small cones and bright red (6). It is usually diclinous (rarely single root), ascending or as shrubs with woody members. The chlorophyll-bearing stem of these plants is responsible for absorbing greenery in them. The male flowers of the complex are in the form of Shatoon inflorescence on the stem axis and have 2 to 3 anthers located on a common rod. Their female flowers are usually located at the end of the branches, individually or in groups of 2-3, enclosed in 2-4 pairs of bracts (two to two opposite). *Ephedra* lacks real fruit. The color of the fruit is red and the seeds are dark brown. The inner bracket of their female flowers becomes woody after the zygote has matured, creating a hard covering for it, while the outer bracket of the carnivore provides the characteristics of a shaft fruit (5). Its root system is very active and sends a wide range of branches. At the end of the surface roots that have spread to the topsoil, the air branches appear in abundant search (7). Some of the following varieties grow in Iran under the following names:

- *E. intermedia* var *intermedia* variety, which is found around Lake Neyriz, Persepolis, Taybat and Uzbek mountains in Khorasan, Tehran, Karaj, and Isfahan.
- *B. E. intermedia* Var *glauca* (Regel) Stapf variety can be seen in the Alborz slopes in Clark, Sorkheh Hesar, Kahrizak, Zarand, Qom, Kashan, Miyaneh, Semnan, Birjand, and Makran.
- *C. E. intermedia* var *persica* Stapf variety in Khorasan, Hezar Masjed, and Chenaran road to Quchan, Birjand to Qaen and in Damghan, Semnan, Shahmirzad, Shahdasht, Varamin, Garmsar and between Nain and Aqda and in the arc at high mountain heights, Khash, Zahedan, Arak, Qahroud Kashan, and in Isfahan and Yazd Khast (8).

### Distribution

*Ephedra distachya* is native to the Mediterranean and other

species of this genus are native to Asia (6). It is often grown in arid and desert areas and is an extremely drought-resistant plant. This plant is found in Zahedan, Manjil, Damghan, Yazd, Lut Desert, Khorasan, Hezar Masjed, Semnan, Shahmirzad, Shahdasht, Robot Karim, Varamin, Chenaran to Quchan and Birjand to Ghaen, Garmsar, Arak, Qahroud Kashan, and southern slopes of Alborz and Isfahan (9).

### Ecological Needs, Cultivation, and Propagation

*Ephedra* often grows in arid and desert areas and it needs well-drained soil. *Ephedra* is an extremely drought-resistant plant with roots that penetrate up to 3 meters into the ground to use moisture. It naturally creates habitats on converging lines 3 mm and above. The height range of the habitat usually varies from 2 to 6 meters above sea level. This plant is often grown in deserts on the Neogene Formation, which has gypsum marine formations. *Ephedra* is propagated by vegetative (rhizome) and reproductive (seed) methods. The presence of *ephedra* populations in nature and horizontal rhizomes extending horizontally from one base to another indicates the asexual reproduction of the plant (10). Sexual reproduction of this plant is done through seeds. The seeds of this plant have a high viability and can be germinated for up to 15 years, but the return time of the percentage of rejuvenation is reduced (11,12). Caldwell et al stated that plant root systems, especially *ephedra* species, have a special morphological formability that enables them to adapt to severe soil changes and moisture conditions (13).

### Constituents

*Ephedra* is widespread in many parts of the world, and its chemical composition depends on the species, plant organ, harvest time, geographical area, and extraction technique; thus different species of *ephedra* may differ pharmacologically (14-16). *Ephedra* is made up of several chemicals, including ephedrine, pseudoephedrine, nor-pseudoephedrine, nor-ephedrine, methyl ephedrine, tannins, kynurenic acid quinoline, etc. (Figure 2). The

minerals found in ephedra are: magnesium, iron, calcium, potassium, copper, nickel, silicon, etc. In fact, ephedrine and pseudoephedrine are different from ephedra, and the ephedra plant has milder effects than ephedrine and pseudoephedrine. This difference is similar to the difference between pure coffee and caffeine (5). *Ephedra sinica* (up to 3.4% dry weight), native to China, is the first commercial source of ephedra alkaloids. The total alkaloid content in *E. monosperma* and *E. equisetina* species is 2.5% and in *E. major*, *E. distachya*, *E. gerardiana*, and *E. nebrodensis* is 1 to 2% of the plant's dry weight (3,17). In addition to alkaloids, other types of secondary metabolites such as flavonoids, flavonols, tannins, carboxylic acids, and volatile terpenes have been reported in this plant (18). Furthermore, ephedra contains tyrosine derivatives, Spermene alkaloids, and procyanidins (6).

### Organs used

The organs used from this plant is its stems and the roots are rarely used. The taste is bitter and astringent. Ephedrine is the first alkaloid to be extracted from ephedra and used for medicinal purposes (5), which dilates bronchitis, strengthens, and stimulates the central nervous system (6). The Aryans used its extract of leaf and fruit as medicine and smoked its stems in temples.

### Traditional Medicine

Ephedra has traditionally been used to treat asthma, bronchitis, and nasal congestion (inflammation of the nose and sinuses). This plant is still used in weight loss products and athletes' strengthening drugs (6). Ephedra has anti-inflammatory and anti-arthritis effects and is widely used to treat colds, flu, headaches, high fever, coughs, joint and bone diseases, etc. This plant has invigorating and healing properties for humans and animals (19). Its stem is less commonly used for therapeutic purposes, so it may sometimes be used as a decoction of 20 g/1000 mL to relieve the effects of rheumatism. Ephedrine and its salts have a similar effect to adrenaline. Ephedrine

use narrows the vascular pathways (vaso-const.), raises blood pressure, opens the pupil of the eye, and especially relieves the effects of asthma. Ephedrine is less toxic than adrenaline, and unlike adrenaline, its effects are more lasting but slightly weaker if taken orally. It has also been experimentally proven to have an anti-rheumatic effect. Ephedrine stimulates uterine contractions, smoky movements of the stomach-intestines, and secretions from the stomach and saliva. Taking it can relieve the annoying side effects of asthma and relieve shortness of breath. In addition, ephedrine has a mosaic effect, relieves coughs, and lowers heat in cases of fever. Other uses for ephedrine include adding morphine and scopolamine to reduce their toxicity. In bronchitis and hemorrhage, not only does it relieve the shortness of breath, but also it soothes coughs and other complications. However, sometimes the use of ephedrine causes heart palpitations, in which case the patient should be given small amounts or discontinued. Ephedrine in patients with prostate inflammation increases the frequency of urination without increasing its amount, plus sometimes causes urinary incontinence (5).

### Method and Amount of Consumption

Dried plants, extracts, tinctures, and alkaloids isolated from this plant are used. Daily intake includes a maximum of 300 mg of total alkaloids of this plant, which is better to be used as individual doses of 15-30 mg of alkaloids for adults. In children, 2 mg of alkaloids per kilogram of body weight is sufficient (6). Ephedrine is used as a pill for 0.01 to 0.05 g at home. Taking a pill of 0.05 g, 2 hours before the onset of the asthma crisis, prevents it from appearing, but in any case, the patient's tolerance should be considered. 0.5 g tablets can be taken once every 2 or 3 days in the morning on an empty stomach, depending on the patient's tolerance, and if less than that amount is needed, 0.5 g tablets can be used. In external use, 0.10 g suppositories or 3% ephedrine solutions in the amount of 1 or 2 drops in alfalfa alum or 3 to 5% ointment are used to affect the nasal mucosa. A 1 to 3% solution of ephedrine, prepared in equal proportions with water and glycerin, is inhaled (5)

### Side Effects

Ephedrine is an illegal substance in sports competitions, and its long-term use can lead to addiction. A number of studies and laboratory studies have shown that taking this drug can cause inconsistencies; therefore, it is recommended to avoid taking it without a doctor's prescription and supervision (6). Research shows that ephedrine consumption in laboratory animals causes uterine contractions. Accordingly, pregnant women should avoid ephedrine. Ephedra often causes sleep disorder, so people with insomnia should avoid it. Another side effect is that it dries the mouth.

Some other side effects of this plant include: complications due to increased energy levels in the body such as anxiety, increased sweating, hot flashes, sleep

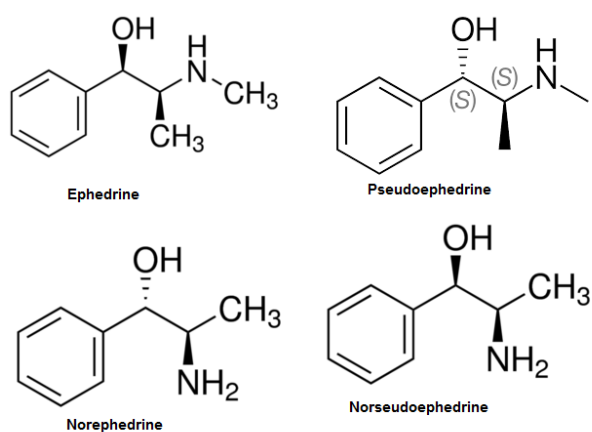


Figure 2. The Structure of Some Major Compounds.

disorders, and insomnia; neurological disorders such as insanity, tremors, burning, itching, fatigue, and headache; disorders in the circulatory system, such as high blood pressure and the possibility of stroke; and complications such as diarrhea, allergies, and increased urination.

### Prohibited Usages

It is contraindicated in pregnant women, nursing mothers, adults with high blood pressure, heart patients, diabetics, people with glaucoma, and people who have very active thyroid glands (8). In addition, sometimes it causes urinary incontinence (5).

### Therapeutic Rank

Ephedra, as a medicinal plant used in traditional medicine, and as an effective medicinal plant in Germany, has a positive therapeutic status and is ranked 1 in the monograph of the World Health Organization. Ephedrine from this plant has been identified and registered as an effective drug used in modern medicine (6).

### Pharmacological Effects

Many studies have been done on the biological properties of the active ingredients in this plant. In addition, its effects on the cardiovascular system and increasing blood pressure, respiratory and airways (20), central nervous system, increasing the level of consciousness (21), weight loss, decreasing body fat and LDL-cholesterol, increasing HDL-cholesterol (22,23) as well as antiviral, antibacterial, antifungal (24,25), and antioxidant (26) effects have been confirmed.

### Other Uses

It is a valuable species in terms of forage (especially for goats), and protection in arid and desert areas, which has long been considered by scientists in domestic and foreign schools and resources. Examining the toxic effects of ephedra on livestock in the middle of April to late June, the plant causes nervous symptoms, drowsiness, blindness, diarrhea, increased gastrointestinal motility, and increased respiration; thus, the best time to use it for direction of grazing is autumn and winter (25).

### Conclusion

Ephedra is a medicinal plant with a 5000-year history of treating asthma, nasal congestion, and central nervous system disorders. The role of this plant and its extract in the treatment of diseases clearly clarifies the need for further study in this field to achieve more definitive results. Due to the numerous medicinal properties attributed to this plant in traditional medicine, more scientific research is needed on the other effects of this plant. Due to the fact that the ephedra plant has the ability to grow in different and unfavorable conditions, its cultivation in large quantities is possible and economical. Given the beneficial medicinal effects of this genus, it can meet some of the

country's needs for the import of chemical drugs. The use of species of the plant with more active ingredients could be preferred to others.

### Conflict of Interests

The authors declare no conflict of interests.

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